

#12

SEQUENCE LISTING

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Tsuboi, Takafumi
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The Government of the United States of America
as represented by the Secretary of the
Department of Health and Human Services

<120> Vaccines for Blocking Transmission of Plasmodium vivax

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<140> US 09/554,960
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<151> 1998-12-04

<160> 24

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<210> 1
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<212> DNA
<213> Plasmodium vivax

<220>
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<222> (147)..(857)
<223> Pvs28

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ttatacaaaa acgactcccc ctttgagata acacccaact gagctcgatt cccctcccc 120
acttttgcgc ctcccccttg ttcaaa atg aat acc tac cac agc ttg ctg ttc 173
Met Asn Thr Tyr His Ser Leu Leu Phe
1 5
ctt ctg gcc atc gtg ctt act gtt aag cac acc ttc gca aag gtc acc 221
Leu Leu Ala Ile Val Leu Thr Val Lys His Thr Phe Ala Lys Val Thr
10 15 20 25
gcg gag acc caa tgc aaa aat ggc tat gta gtc caa atg agc aat cat 269
Ala Glu Thr Gln Cys Lys Asn Gly Tyr Val Val Gln Met Ser Asn His
30 35 40
ttt gaa tgc aaa tgc aac gac ggg ttt gtt atg gca aat gaa aac act 317
Phe Glu Cys Lys Cys Asn Asp Gly Phe Val Met Ala Asn Glu Asn Thr
45 50 55
tgc gag gaa aaa cgc gat tgc aca aat cca caa aat gta aat aaa aac 365
Cys Glu Glu Lys Arg Asp Cys Thr Asn Pro Gln Asn Val Asn Lys Asn
60 65 70

tgt gga gac tac gct gtg tgt gca aac acc aga atg aat gat gag gaa	413
Cys Gly Asp Tyr Ala Val Cys Ala Asn Thr Arg Met Asn Asp Glu Glu	
75 80 85	
aga gca tta cga tgc ggc tgc ata tta ggg tac acc gta atg aat gag	461
Arg Ala Leu Arg Cys Gly Cys Ile Leu Gly Tyr Thr Val Met Asn Glu	
90 95 100 105	
gtg tgt act cca aat aaa tgt aac ggc gtt ttg tgt gga aag gga aag	509
Val Cys Thr Pro Asn Lys Cys Asn Gly Val Leu Cys Gly Lys Gly Lys	
110 115 120	
tgc atc tta gat ccc gct aat gtg aac agc acc atg tgc tct tgt aat	557
Cys Ile Leu Asp Pro Ala Asn Val Asn Ser Thr Met Cys Ser Cys Asn	
125 130 135	
ata gga acc aca ttg gat gaa tct aaa aaa tgt gga aag cca gga aaa	605
Ile Gly Thr Thr Leu Asp Glu Ser Lys Lys Cys Gly Lys Pro Gly Lys	
140 145 150	
act gaa tgc acg ttg aag tgt aag gca aac gaa gaa tgt aaa gag act	653
Thr Glu Cys Thr Leu Lys Cys Lys Ala Asn Glu Glu Cys Lys Glu Thr	
155 160 165	
cag aat tat tac aag tgc gtt gcg aag gga agc ggc gga gaa ggc agc	701
Gln Asn Tyr Tyr Lys Cys Val Ala Lys Gly Ser Gly Gly Glu Gly Ser	
170 175 180 185	
ggt gga gaa ggc agc ggc gga gag ggc agc ggc gga gag ggc agc ggc	749
Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly	
190 195 200	
gga gag ggc agc ggt gga gac aca gga gca gct tac agt ctc atg aac	797
Gly Glu Gly Ser Gly Gly Asp Thr Gly Ala Ala Tyr Ser Leu Met Asn	
205 210 215	
gga tct gca gta atc agc ata cta ctt gta ttc gcc ttc ttc atg atg	845
Gly Ser Ala Val Ile Ser Ile Leu Leu Val Phe Ala Phe Phe Met Met	
220 225 230	
tca tta gtg tagacgattc tacacacaca cacaacata cacaagggga	894
Ser Leu Val	
235	
gaagcgtctc acagagtcag ttcaagtcac acgcacaaaa aaggaaagta catccagctg	954
gtgaaagagc atttatgtgt gcagttatcc ttgggagaag caccctccac ccagttgcgt	1014
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<212> PRT	
<213> Plasmodium vivax	
<400> 2	
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Val Lys His Thr Phe Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn
 20 25 30
 Gly Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp
 35 40 45
 Gly Phe Val Met Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys
 50 55 60
 Thr Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys
 65 70 75 80
 Ala Asn Thr Arg Met Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys
 85 90 95
 Ile Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys
 100 105 110
 Asn Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn
 115 120 125
 Val Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu
 130 135 140
 Ser Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys
 145 150 155 160
 Lys Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val
 165 170 175
 Ala Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 180 185 190
 Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp
 195 200 205
 Thr Gly Ala Ala Tyr Ser Leu Met Asn Gly Ser Ala Val Ile Ser Ile
 210 215 220
 Leu Leu Val Phe Ala Phe Phe Met Met Ser Leu Val
 225 230 235

<210> 3
 <211> 995
 <212> DNA
 <213> Plasmodium vivax

<220>
 <221> CDS
 <222> (255)..(914)
 <223> Pvs25

<400> 3
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 tttcgattgt ttgcttgttt gcttttttgc ttattcgccc gtttttccgc ttgcccgttc 120
 gcccgctcca caacgcgccg ctgcaaaggt tgcccaccac cgaccacaaa aacttattca 180
 ccaccatccg agcggaaagg aacgccgccc actgtgctgc ctacctcccc gaataacaac 240

tccacttagc	caa	atg	aac	tcc	tac	agc	ctc	ttc	gtt	ttt	ttc	ctc	290			
		Met	Asn	Ser	Tyr	Tyr	Ser	Leu	Phe	Val	Phe	Leu				
		1				5				10						
gtc	caa	att	gcg	cta	aag	tat	agc	aag	gca	gcc	gtc	acg	gta	gac	acc	338
Val	Gln	Ile	Ala	Leu	Lys	Tyr	Ser	Lys	Ala	Ala	Val	Thr	Val	Asp	Thr	
		15				20						25				
ata	tgc	aaa	aat	gga	cag	ctg	gtt	caa	atg	agt	aac	cac	ttt	aag	tgt	386
Ile	Cys	Lys	Asn	Gly	Gln	Leu	Val	Gln	Met	Ser	Asn	His	Phe	Lys	Cys	
		30				35					40					
atg	tgt	aac	gaa	ggg	ctg	gtg	cac	ctt	tcc	gaa	aat	aca	tgt	gaa	gaa	434
Met	Cys	Asn	Glu	Gly	Leu	Val	His	Leu	Ser	Glu	Asn	Thr	Cys	Glu	Glu	
		45			50					55					60	
aaa	aat	gaa	tgc	aag	aaa	gaa	acc	cta	ggc	aaa	gca	tgc	ggg	gaa	ttt	482
Lys	Asn	Glu	Cys	Lys	Lys	Glu	Thr	Leu	Gly	Lys	Ala	Cys	Gly	Glu	Phe	
				65					70					75		
ggc	cag	tgt	ata	gaa	aac	cca	gac	cca	gca	cag	gta	aac	atg	tac	aaa	530
Gly	Gln	Cys	Ile	Glu	Asn	Pro	Asp	Pro	Ala	Gln	Val	Asn	Met	Tyr	Lys	
			80					85					90			
tgt	ggt	tgc	att	gag	ggc	tac	act	ttg	aag	gaa	gac	act	tgt	gtg	ctt	578
Cys	Gly	Cys	Ile	Glu	Gly	Tyr	Thr	Leu	Lys	Glu	Asp	Thr	Cys	Val	Leu	
		95				100						105				
gat	gta	tgt	caa	tac	aaa	aat	tgt	gga	gaa	agt	ggc	gaa	tgc	att	gtt	626
Asp	Val	Cys	Gln	Tyr	Lys	Asn	Cys	Gly	Glu	Ser	Gly	Glu	Cys	Ile	Val	
		110				115					120					
gag	tac	ctc	tcg	gaa	atc	caa	agt	gca	ggt	tgc	tca	tgt	gct	att	ggc	674
Glu	Tyr	Leu	Ser	Glu	Ile	Gln	Ser	Ala	Gly	Cys	Ser	Cys	Ala	Ile	Gly	
		125			130					135					140	
aaa	gtc	ccc	aat	cca	gaa	gat	gag	aaa	aaa	tgt	acc	aaa	acg	gga	gaa	722
Lys	Val	Pro	Asn	Pro	Glu	Asp	Glu	Lys	Lys	Cys	Thr	Lys	Thr	Gly	Glu	
				145				150						155		
act	gct	tgt	caa	ttg	aaa	tgt	aac	aca	gat	aat	gaa	gtc	tgc	aaa	aat	770
Thr	Ala	Cys	Gln	Leu	Lys	Cys	Asn	Thr	Asp	Asn	Glu	Val	Cys	Lys	Asn	
			160					165					170			
gtt	gaa	gga	gtt	tac	aag	tgc	cag	tgt	atg	gaa	ggc	ttt	acg	ttc	gac	818
Val	Glu	Gly	Val	Tyr	Lys	Cys	Gln	Cys	Met	Glu	Gly	Phe	Thr	Phe	Asp	
		175					180					185				
aaa	gag	aaa	aat	gta	tgc	ctt	tcc	tat	tct	gta	ttt	aac	atc	cta	aac	866
Lys	Glu	Lys	Asn	Val	Cys	Leu	Ser	Tyr	Ser	Val	Phe	Asn	Ile	Leu	Asn	
		190				195				200						
tac	tcc	ctc	ttc	ttt	atc	atc	ctg	ctt	gtc	ctt	tcg	tac	gtc	ata		911
Tyr	Ser	Leu	Phe	Phe	Ile	Ile	Leu	Le								

<210> 4
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 <212> PRT
 <213> Plasmodium vivax

<400> 4
 Met Asn Ser Tyr Tyr Ser Leu Phe Val Phe Phe Leu Val Gln Ile Ala
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 Leu Lys Tyr Ser Lys Ala Ala Val Thr Val Asp Thr Ile Cys Lys Asn
 20 25 30
 Gly Gln Leu Val Gln Met Ser Asn His Phe Lys Cys Met Cys Asn Glu
 35 40 45
 Gly Leu Val His Leu Ser Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys
 50 55 60
 Lys Lys Glu Thr Leu Gly Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile
 65 70 75 80
 Glu Asn Pro Asp Pro Ala Gln Val Asn Met Tyr Lys Cys Gly Cys Ile
 85 90 95
 Glu Gly Tyr Thr Leu Lys Glu Asp Thr Cys Val Leu Asp Val Cys Gln
 100 105 110
 Tyr Lys Asn Cys Gly Glu Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser
 115 120 125
 Glu Ile Gln Ser Ala Gly Cys Ser Cys Ala Ile Gly Lys Val Pro Asn
 130 135 140
 Pro Glu Asp Glu Lys Lys Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln
 145 150 155 160
 Leu Lys Cys Asn Thr Asp Asn Glu Val Cys Lys Asn Val Glu Gly Val
 165 170 175
 Tyr Lys Cys Gln Cys Met Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn
 180 185 190
 Val Cys Leu Ser Tyr Ser Val Phe Asn Ile Leu Asn Tyr Ser Leu Phe
 195 200 205
 Phe Ile Ile Leu Leu Val Leu Ser Tyr Val Ile
 210 215

<210> 5
 <211> 377
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs25-Pvs28
 fusion protein

<400> 5
 Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly Gln Leu Val Gln Met
 1 5 10 15

Ala Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 340 345 350

Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp
 355 360 365

Thr Gly Ala Ala Tyr Ser Leu Met Asn
 370 375

<210> 6
 <211> 21
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:sense primer

<400> 6
 ggwtttytrr ytcaratgag t 21

<210> 7
 <211> 17
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:vector-specific
 M13 universal primer

<400> 7
 gtaaaacgac ggccagt 17

<210> 8
 <211> 24
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:internal
 degenerate sense primer

<400> 8
 tcaratgagt rrycatttdg aatg 24

<210> 9
 <211> 25
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:PCR-sense
 splinkerette #1 primer

<400> 9
 cgaatcgtaa ccgttcgtac gagaa 25

<210> 10
 <211> 20
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:antisense Pvs25
 specific primer

<400> 10
 ggacaagcag gatgataaaag 20

<210> 11
 <211> 25
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:nested PCR
 sense splinkerette #2 internal primer

<400> 11
 tcgtaccaga atcgctgtcc tctcc 25

<210> 12
 <211> 21
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:anti-sense
 Pvs25 specific internal primer

<400> 12
 agcacacaag tgtcttcctt c 21

<210> 13
 <211> 18
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:gene specific
 PCR sense primer

<400> 13
 actttcgttt cacagcac 18

<210> 14
 <211> 20
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:gene specific
 PCR anti-sense primer

<400> 14
aaaggacaag caggatgata

20

<210> 15
<211> 7
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:flexible linker

<400> 15
Gly Gly Gly Pro Gly Gly Gly
1 5

<210> 16
<211> 186
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Pvs25 fusion
protein

<400> 16
Glu Ala Glu Ala Ser Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly
1 5 10 15
Gln Leu Val Gln Met Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly
20 25 30
Leu Val His Leu Ser Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys
35 40 45
Lys Glu Thr Leu Gly Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu
50 55 60
Asn Pro Asp Pro Ala Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu
65 70 75 80
Gly Tyr Thr Leu Lys Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr
85 90 95
Lys Asn Cys Gly Glu Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu
100 105 110
Ile Gln Ser Ala Gly Cys Ser Cys Ala Ile Gly Lys Val Pro Glu Pro
115 120 125
Glu Asp Glu Lys Lys Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu
130 135 140
Lys Cys Asn Thr Asp Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr
145 150 155 160
Lys Cys Gln Cys Met Glu Gly Phe Thr Phe Cys Lys Glu Lys Asn Val
165 170 175

Cys Leu Gly Pro His His His His His His
 180 185

<210> 17
 <211> 205
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28 fusion
 protein

<400> 17
 Glu Ala Glu Ala Ser Lys Val Thr Ala Glu Thr Gln Cys Lys Asn Gly
 1 5 10 15
 Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly
 20 25 30
 Phe Val Leu Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr
 35 40 45
 Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala
 50 55 60
 Asn Thr Arg Met Asn Asn Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile
 65 70 75 80
 Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Tyr Lys Cys Asn
 85 90 95
 Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val
 100 105 110
 Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Ser Thr Leu Asp Glu Ser
 115 120 125
 Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys
 130 135 140
 Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala
 145 150 155 160
 Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu
 165 170 175
 Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp Thr
 180 185 190
 Gly Ala Ala Tyr Ser Gly Pro His His His His His His
 195 200 205

<210> 18
 <211> 205
 <212> PRT
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:Pvs28Q130
fusion protein

<400> 18

Glu	Ala	Glu	Ala	Ser	Lys	Val	Thr	Ala	Glu	Thr	Gln	Cys	Lys	Asn	Gly	1	5	10	15
Tyr	Val	Val	Gln	Met	Ser	Asn	His	Phe	Glu	Cys	Lys	Cys	Asn	Asp	Gly	20	25	30	
Phe	Val	Leu	Ala	Asn	Glu	Asn	Thr	Cys	Glu	Glu	Lys	Arg	Asp	Cys	Thr	35	40	45	
Asn	Pro	Gln	Asn	Val	Asn	Lys	Asn	Cys	Gly	Asp	Tyr	Ala	Val	Cys	Ala	50	55	60	
Asn	Thr	Arg	Met	Asn	Asn	Glu	Glu	Arg	Ala	Leu	Arg	Cys	Gly	Cys	Ile	65	70	75	80
Leu	Gly	Tyr	Thr	Val	Met	Asn	Glu	Val	Cys	Thr	Pro	Tyr	Lys	Cys	Asn	85	90	95	
Gly	Val	Leu	Cys	Gly	Lys	Gly	Lys	Cys	Ile	Leu	Asp	Pro	Ala	Asn	Val	100	105	110	
Gln	Ser	Thr	Met	Cys	Ser	Cys	Asn	Ile	Gly	Ser	Thr	Leu	Asp	Glu	Ser	115	120	125	
Lys	Lys	Cys	Gly	Lys	Pro	Gly	Lys	Thr	Glu	Cys	Thr	Leu	Lys	Cys	Lys	130	135	140	
Ala	Asn	Glu	Glu	Cys	Lys	Glu	Thr	Gln	Asn	Tyr	Tyr	Lys	Cys	Val	Ala	145	150	155	160
Lys	Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Glu	165	170	175	
Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Asp	Thr	180	185	190	
Gly	Ala	Ala	Tyr	Ser	Gly	Pro	His	His	His	His	His	His	His			195	200	205	

<210> 19

<211> 169

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:Pvs28NCR fusion
protein

<400> 19

Glu	Ala	Glu	Ala	Ser	Lys	Val	Thr	Ala	Glu	Thr	Gln	Cys	Lys	Asn	Gly	1	5	10	15
Tyr	Val	Val	Gln	Met	Ser	Asn	His	Phe	Glu	Cys	Lys	Cys	Asn	Asp	Gly	20	25	30	

Phe Val Leu Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr
 35 40 45
 Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala
 50 55 60
 Asn Thr Arg Met Asn Asn Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile
 65 70 75 80
 Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Tyr Lys Cys Asn
 85 90 95
 Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val
 100 105 110
 Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Ser Thr Leu Asp Glu Ser
 115 120 125
 Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys
 130 135 140
 Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala
 145 150 155 160
 Lys Gly Pro His His His His His His
 165

<210> 20

<211> 174

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:Pvs25 domain of
Pvs25-Pvs28 fusion protein

<400> 20

Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly Gln Leu Val Gln Met
 1 5 10 15
 Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly Leu Val His Leu Ser
 20 25 30
 Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys Lys Glu Thr Leu Gly
 35 40 45
 Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu Asn Pro Asp Pro Ala
 50 55 60
 Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu Gly Tyr Thr Leu Lys
 65 70 75 80
 Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr Lys Asn Cys Gly Glu
 85 90 95
 Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu Ile Gln Ser Ala Gly
 100 105 110
 Cys Ser Cys Ala Ile Gly Lys Val Pro Asn Pro Glu Asp Glu Lys Lys
 115 120 125

Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu Lys Cys Asn Thr Asp
 130 135 140

Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr Lys Cys Gln Cys Met
 145 150 155 160

Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn Val Cys Leu Ser
 165 170

<210> 21
 <211> 196
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28 domain of
 Pvs25-Pvs28 fusion protein

<400> 21
 Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn Gly Tyr Val Val Gln
 1 5 10 15
 Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly Phe Val Met Ala
 20 25 30
 Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr Asn Pro Gln Asn
 35 40 45
 Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala Asn Thr Arg Met
 50 55 60
 Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile Leu Gly Tyr Thr
 65 70 75 80
 Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys Asn Gly Val Leu Cys
 85 90 95
 Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val Asn Ser Thr Met
 100 105 110
 Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu Ser Lys Lys Cys Gly
 115 120 125
 Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys Ala Asn Glu Glu
 130 135 140
 Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala Lys Gly Ser Gly
 145 150 155 160
 Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 165 170 175
 Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp Thr Gly Ala Ala Tyr
 180 185 190
 Ser Leu Met Asn
 195

<210> 22
<211> 4
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:sequence added
to enhance cleavage of alpha factor leader

<400> 22
Glu Ala Glu Ala
1

<210> 23
<211> 9
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:sequence added
to enhance cleavage of alpha factor leader

<400> 23
Glu Ala Glu Ala Glu Ala Glu Ala Lys
1 5

<210> 24
<211> 6
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:polyhistidine
tag

<400> 24
His His His His His His
1 5